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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appln No.:	~~09/682,492~~ 09/682496	Confirmation No. 6022
Applicants:	Johan Lindström et al.	
Filed:	July 9, 2001	
For:	Method and Arrangement for Controlling a Drive System	
TC/A.U.:	2837	
Examiner:	Tyrone W. Smith	
Docket No.:	79228	
Customer No.:	22242	

CERTIFICATE OF MAILING

I hereby certify that this paper (along with any papers referred to as being attached or enclosed) is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on this date.

7/1/04
Date

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APPEAL BRIEF

Commissioner for Patents
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Pursuant to 37 C.F.R.§1.192, the applicants hereby respectfully submit the following Brief in support of their appeal. Pursuant to 37 C.F.R. §1.192(a) this brief is being filed in triplicate.

(1) Real Party in Interest

The real party in interest is Volvo Personvagnar AB of Sweden.

(2) Related Appeals and Interferences

There are no related appeals or interferences known to appellant, the appellant's legal representative, or assignee that will directly affect, or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

Claims 1-23 are pending. Claims 3 through 5, 9 through 11, and 20 through 22 are allowed. Claims 1, 2, 6 through 8, 12 through 19, and 23 presently stand twice and finally rejected and constitute the subject matter of this appeal.

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(4) Status of Amendments

There are no currently unentered amendments.

(5) Summary of Invention

This summary will perhaps be better understood with reference to FIG. 1 (reproduced below for the convenience of the reader).

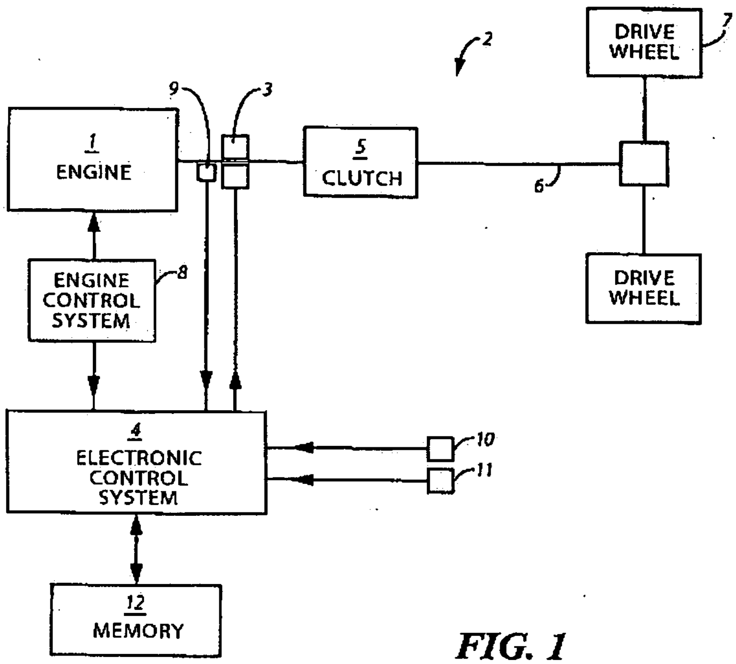


FIG. 1

This invention addresses a concern that can arise when torque in the drive train of a motor vehicle suddenly changes. Sudden significant positive or negative changes in torque as between the motor vehicle engine and the drive wheel axle(s) can produce unwanted vibration and/or winding up of one or more elements of the drive train. [Page 1, paragraph 0002.] This invention seeks to address this problem, at least in part, by providing the drive line with torsional preloading. [Page 2, paragraph 0006.]

In one embodiment, the motor vehicle drive system comprises an internal combustion engine (1) that couples to a drive line (2) that comprises an electric motor (3). The system further comprises an electronic control system (4) that controls, at least in part, the operation of the electric motor (3). [Page 4, paragraph 0018.] The electronic control system (4) obtains data from an engine control system (8) that

controls, at least in part, operation of the engine (1) and further couples to a sensor (9) that monitors, for example, the output shaft of the drive engine (1). (This system can also include other additional torque sensors (10, 11) that are positioned elsewhere on the drive line (2).) The electronic control system (4) also couples to a memory (12) that contains data in a matrix. [Page 5, paragraph 0019.]

This memory (12) stores information that characterizes pulses. These pulses vary with respect to height and duration and can have varying forms.[1] This pulse information correlates to presently detected play in the drive line as measured, for example, by the torque sensor (9) mentioned above. Upon detecting that a change in load is imminent (as versus sensing that such a change has already occurred), the electronic control system (4) uses presently sensed torque information to select a particular pulse from the memory (12) and uses that pulse information to send a single preloading torque pulse to the electric motor (3) to thereby cause the latter to preload the drive line (2) and thereby avoid the vibration and/or winding up issues noted earlier. This pulse, regardless of shape, height, or duration, is sent *only once* upon detecting such an imminent change in loading. [Page 3, paragraphs 0007 – 0009.]

This invention does not address immediately correcting a torsional loading imbalance that is already underway. In other words, this invention does not sense that a torsional imbalance is occuring and then take action to mitigate the extent or duration of that imbalance. Instead, these embodiments seek to respond to indicia of a likely imminent torsional imbalance and to take steps based upon present loading information to mitigate the extent of duration of the imbalance using but a single torque pulse when it does occur.

Pursuant to some embodiments torsional readings can be used to modify (or to supplement) the pulse information as stored in the memory (12). So configured, such an embodiment provides no direct feedback useful for continuous regulation, but does

1 As noted in the specification, "The pulse can have varying forms, such as an individual square pulse, a repeated square pulse with uniform or varying intervals, a ramped or sawtooth-shaped pulse, or a sinusoidal pulse, which can have both positive and negative values." [Page 3, paragraph 0009.]

permit self-learning that can adapt the functioning of the control system over time with respect to its individual behaviors and circumstances. [Pages 3/4, paragraph 0010.]

(6) Issues

Claims 1, 2, 6 through 8, 12 through 19, and 23 are rejected under 35 U.S.C. 102(a) given Ranson et al. (GB 2346351A) ("Ranson") and under 35 U.S.C. 102(e) given Strandell et al. (U.S. Patent No. 6,505,109) ("Strandell").

(7) Grouping of claims

For purposes of the present appeal the applicant is content to permit all of the rejected claims to be viewed as a single group.

(8) Argument

Rejections under 35 U.S.C. 102

Prior to discussing the rejection of these claims, the applicant believes it would be helpful to first briefly describe and characterize the two relied-upon prior art references of record.

The Ranson reference

Ranson describes the use of an electric motor to dampen torque changes in a motor vehicle. With reference to FIG. 1 from Ranson (reproduced below for the convenience of the reader), this reference teaches provision of:

> [A] vehicle having an engine 10, a clutch 11 and a gearbox 12 driving the wheels 16 through a propeller shaft 20[. A]n electric motor 13 is provided to supply or absorb torque from the propeller shaft to reduce oscillations in the drive line cause[d] by rapid torque changes. An electronic control means controls the motor 13 on the basis of torque signals from sensors 29, 30, 33 and 34, the back emf of the motor and preprogrammed information regarding the expected torque changes due to driver demand. [Abstract.]

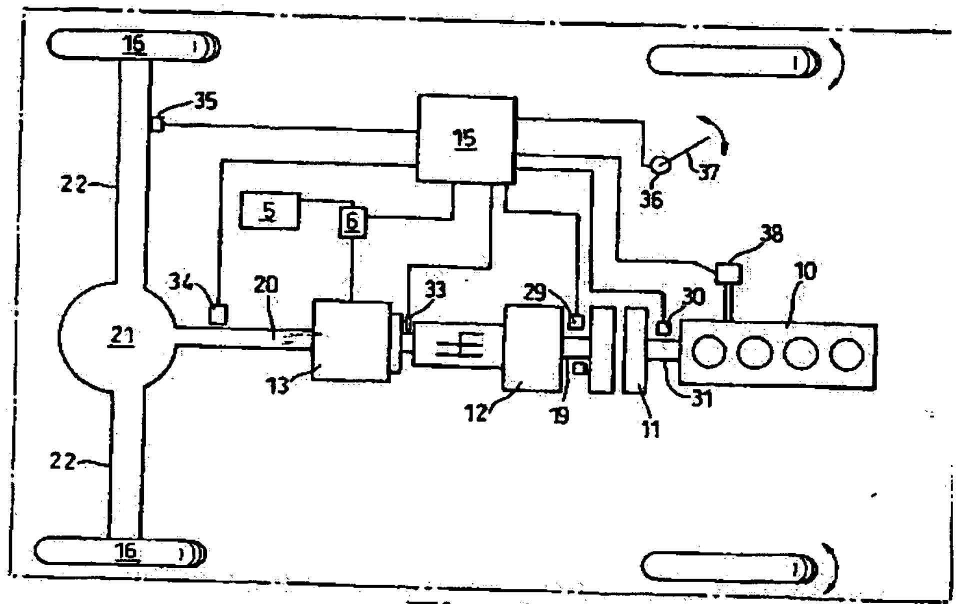


Fig. 1

Some of Ranson's embodiments are reactive – that is, they teach a way of responding to a torque imbalance that has already commenced. At least one embodiment appears to be more proactive. In this embodiment, the electronic control means 115 "is programmed to control the electric motor 113 in response to the signal produced by the sensor 136 attached to the accelerator pedal 137 so as to prevent the rapid transfer of torque from the engine 110 to the propshaft 120." [Page 6, lines 1 – 3.] In this regard, Ranson further teaches that:

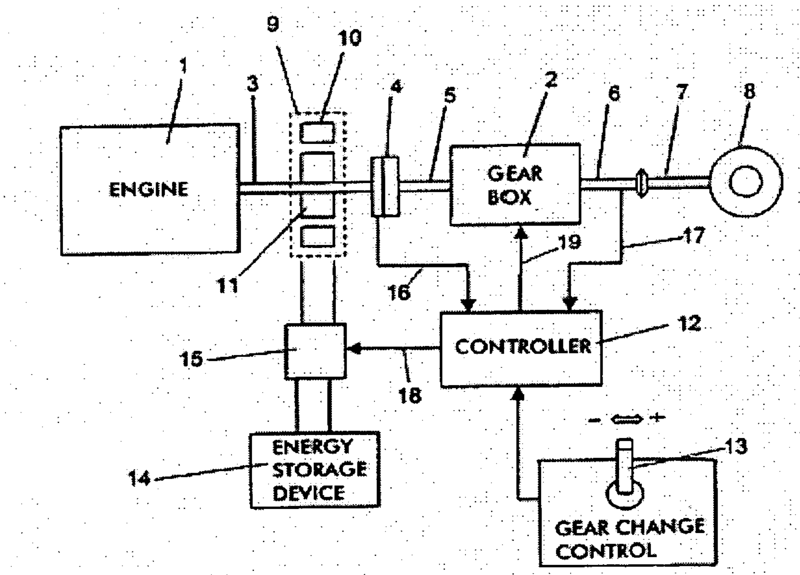
> The electronic control means 115 is pre-programmed with the likely driveline response to numerous changes in driver demand and from this pre-programmed information it can control the electric motor 113 to dampen out excessive oscillations by either resisting rotation of the input shaft 119 or by providing a positive drive to the input shaft 119 depending upon the predicted state of the driveline. For example, if overshoot is predicted to occur the electric motor is energised to resist rotation of the propeller shaft 120 whereas if undershoot is predicted to occur the electric motor 113 is energised to produce a positive drive to the propeller shaft 120 in the same direction as the torque applied by the engine 110.

In this way the electric motor 113 acts [as] an active damper to reduce driveline oscillations and improve driveline refinement. [Page 6, lines 4 – 13.]

Ranson makes no teaching or suggestion that such control comprises only a single torque-inducing pulse. Ranson only teaches the more general notion that an electric motor can be used to dampen excessive oscillations by resisting (or inducing) rotation of the drive line shaft in what obviously appears to refer to more continuous control.

The Strandell reference

Strandell describes an arrangement and a method for a drive unit of a vehicle. FIG. 1 from Strandell appears below for the convenience of the reader.



A drive unit comprises an engine (1) and a mechanical stepped gearbox (2). A connecting device transmits rotary motion from the first to the second. This connecting device incorporates an output shaft (3) from the engine (1), a clutch (4), and an input shaft (5) to the gearbox (2). Driving power leads from the gearbox output shaft (6) via a propeller shaft (7) to the vehicle's driving wheels (8). Strandell seeks to makes it possible to execute gear changing in the gearbox (2) without using the clutch (4).

A so-called electric rotor machine (9) is arranged on the engine's output shaft (3). The electric rotor machine (9) has a stator (10) and a rotor (11) that are disposed on the

output shaft (3). This rotor machine (9) acts upon the output shaft (3) so that substantially no torque is transmitted during the disengagement and engagement of gears in the gearbox (2).

A control unit (12) controls the electric rotor machine (9). When a driver of the vehicle wishes to engage a higher or lower gear in the gearbox (2), a gearchange control (13) is moved in the desired direction, and a signal is sent to this control unit (12). The control unit (12) receives a signal (16) concerning the speed of the engine (1) and another signal (17) concerning the speed of the output shaft (6) of the gearbox (2). Strandell also suggests alternatively detecting the speed of the vehicle's propeller shaft (7) or driving wheels (8).

Strandell teaches that before disengagement of a gear in the gearbox (2) the control unit (12) calculates the torque that the electric rotor machine should provide to the engine output shaft (3) so that the gearwheels enmeshed in the gearbox (2) will not be subject to any torque. The control unit (12) sends a signal (18) to the control device (15) that is designed to control the energy flow between the electric rotor machine (9) and an energy storage device (14). The control device (15) then controls the electric rotor machine (9) so that the latter delivers a calculated torque to the output shaft (3) of the engine (1). The control unit (12) then sends a signal (19) to the gearbox (2), whereupon the gear concerned can be disengaged.

When positive torque is transmitted to the gearbox before the disengagement of a gear in the gearbox, the electric rotor machine (9) functions as a generator and retards the shaft (3). This results in electrical energy being supplied to the energy storage device (14). When negative torque is transmitted to the gearbox (2) before the disengagement of a gear in the gearbox, the electric rotor machine (9) functions as a motor and supplies torque to the shaft (3) with energy being drawn from the energy storage device (14).

The control unit (12) then calculates the speed which the shaft (3) must have at the time of engagement of a gear in order to bring about a synchronous speed between the relevant gearwheels that are intended to mesh with one another in the gearbox (2). The control unit (12) then sends a signal (18) to the control device (15) that controls the

provision of energy to the electric rotor machine (9). During upward gear changing, the control device (15) controls the energy flow to the rotor machine so that the latter functions as a generator and retards the output shaft (3) to the calculated speed. During downward gear changing, the control device (15) adjusts the energy flow to the rotor machine (9) so that the latter functions as a motor and accelerates the output shaft (3). When the shaft (3) reaches the desired speed, which may be indicated to the control unit (12) by the signal (16), the control unit (12) sends a signal (19) to the gearbox (2), whereupon the gear concerned is engaged. [Column 3, line 47 – column 5, line 13.]

Strandell makes no teaching or suggestion that such control comprises only a single torque-inducing pulse. Strandell only teaches the more general notion that an electric motor can be used to eliminate torque when taking certain disconnection and connection actions with respect to a gearbox in what obviously appears to refer to continuous control as versus a single torque-inducing pulse.

The rejection of the claims

All of the claims of this group have been rejected as being anticipated by either Ranson or Strandell. While both references provide teachings regarding the use of an electric motor to induce or dampen torsional loading on a drive shaft in a motor vehicle, neither reference provides an explicit teaching, or makes any suggestion, that such control be effected through use of one, and only one, torque pulse as exerted by the electric motor. The claims of this group, however, make specific provision on this point.

Independent claim 1 provides that control of the electric motor occurs by "prompting exactly one torque pulse from the electric motor to take up play in the drive line before torque from the drive engine occurs." While both Ranson and Strandell speak of using an electric motor to impose torsional influence on the drive line, neither reference makes mention of using only "exactly one torque pulse."

Similarly, both independent claim 7 and 16 also provide for an electric motor that "generates exactly one torque pulse for the purpose of taking up play in the drive line before torque from the drive engine occurs.

The applicant therefore respectfully submits that the independent claims of this grouping include at least this one specific limitation that is not met by either reference. The Examiner has made the following observation and argument in this regard:

> Examiner believes that "a" as defined in Merriam-Webster's Collegiate Dictionary 10th Ed to mean one designation or used before a singular noun, in this case "a" torque pulse from the electric motor means one torque pulse from the electric motor.

With all due respect, the applicant believes that such an observation misses the essential point. The language in the claims regarding "exactly one torque pulse" clearly means *only* one torque pulse and not merely one torque pulse of possibly many torque pulses. This clear and unambiguous grammatical interpretation also accords with the specification itself, where the applicant has written:

> It is important that the pulse, irrespective of shape, height and duration, is sent *only once* when an imminent change in load is detected. [Emphasis provided.] [Page 3, paragraph 0009.]

The applicant therefore respectfully avers that the claims of this grouping include a requirement that only one torque pulse be expressed. The prior art references, however, make no such teaching. Instead, their general descriptions regarding realtime and/or continuous control are clearly suggestive of the opposite – longer term control of the electric motor that is incompatible with the notion of only a single torque pulse that occurs *before* torque from the drive engine ever occurs.

The applicant therefore respectfully submits that the claims of this group are allowable over the references of record and should be passed to allowance.

(9) Appendix

1. (Previously Amended) A method for taking up play in a drive system when a change in load occurs, the method comprising the steps of:

coupling a drive engine to a drive line in a vehicle,

acting on the drive engine and/or the drive line with a driving or braking torque by an electric motor, wherein the motor is coupled to the drive engine or constitutes a part of the drive line; and

controlling the electric motor by a control system, wherein the control system sends a pulse to the electric motor when a change in load occurs, thereby prompting exactly one torque pulse from the electric motor to take up play in the drive line before torque from the drive engine occurs.

2. (Original) The method according to claim 1 further comprising the step of measuring torque applied to the drive line in current operating conditions.

3. (Previously Amended) A method for taking up play in a drive system when a change in load occurs, the method comprising the steps of:

coupling a drive engine to a drive line in a vehicle,

acting on the drive engine and/or the drive line with a driving or braking torque by an electric motor, wherein the motor is coupled to the drive engine or constitutes a part of the drive line;

controlling the electric motor by a control system, wherein the control system sends a pulse to the electric motor when a change in load occurs, thereby prompting a torque pulse from the electric motor to take up play in the drive line before torque from the drive engine occurs, and

measuring torque applied to the drive line in current operating conditions;

selecting the height and/or duration of the pulse from a matrix in a memory based on the torque applied.

4. (Original) The method according to claim 3 further comprising the step of measuring the degree to which the torque pulse takes up the play in the drive line.

5. (Original) The method according to claim 4 further comprising the step of correcting the size of the pulse for the current operating conditions in said matrix on the basis of how the torque pulse from the electric motor has taken up the play.

6. (Original) The method according to claim 1 further comprising the step of sending the pulse when the change in load in the drive line goes from negative (M_g) to positive (M_c) torque.

7. (Previously amended) A drive system for implementing the method according to Claim 1, the drive system comprising:

a drive engine coupled to a drive line in a vehicle,

an electric motor able to act on the drive engine and/or the drive line with a driving or braking torque, and

a control system for controlling the electric motor, wherein the control system, wherein the control system is arranged so as to send a short pulse to the electric motor when a change in load occurs, and wherein the electric motor generates exactly one torque pulse for the purpose of taking up play in the drive line before torque from the drive engine occurs.

8. (Original) The method according to claim 7 wherein the electric motor is further comprised of an integrated starter motor and generator.

9. (Previously Amended) A drive system for implementing the method according to Claim 1, the drive system comprising:

a drive engine coupled to a drive line in a vehicle,

an electric motor comprised of an integrated started motor and generator and able to act on the drive engine and/or the drive line with a driving or braking torque, and

a control system for controlling the electric motor, wherein the control system, wherein the control system is arranged so as to send a short pulse to the electric motor when a change in load occurs, and wherein the electric motor generates a torque pulse for the purpose of taking up play in the drive line before torque from the drive engine occurs, wherein the control system is further comprised of a matrix stored in a memory, wherein the size and duration of the pulse are linked to different operating conditions.

10. (Original) The drive system according to claim 9 wherein the drive line is further comprised of at least one sensor for measuring the effect of the torque pulse on the play in the drive line.

11. (Original) The drive system according to claim 10 wherein the control system is arranged so as to correct the size of the pulse in the matrix in the light of measured values from said sensors.

12. (Original) The drive system according to claim 7 wherein the change in load occurs when the drive engine changes from engine braking to driving.

13. (Original) The drive system according to claim 7 wherein the drive engine is an internal combustion engine.

14. (Original) The drive system according to claim 7 wherein the electric motor is coupled to the drive engine.

15. (Original) The drive system according to claim 7 wherein the electric motor constitutes a part of the drive line.

16. (Previously Amended) A drive system arrangement for taking up play in a drive line when a change in load occurs in the drive system, the drive system arrangement comprising:

a drive engine coupled to a drive line in a vehicle,

an electric motor able to act on the drive engine and/or the drive line with a driving or braking torque, and

a control system for controlling the electric motor and arranged so as to send a short pulse to the electric motor when a change in load occurs,

wherein the electric motor generates exactly one torque pulse for the purpose of taking up play in the drive line before torque from the drive engine occurs.

17. (Original) The drive system arrangement according to claim 16 wherein the drive engine is an internal combustion engine.

18. (Original) The drive system arrangement according to claim 16 wherein the electric motor is coupled to the drive engine.

19. (Original) The drive system arrangement according to claim 16 wherein the electric motor constitutes a part of the drive line.

20. (Previously Amended) A drive system arrangement for taking up play in a drive line when a change in load occurs in the drive system, the drive system arrangement comprising:

a drive engine coupled to a drive line in a vehicle,

an electric motor able to act on the drive engine and/or the drive line with a driving or braking torque, and

a control system for controlling the electric motor and arranged so as to send a short pulse to the electric motor when a change in load occur, wherein the control system is comprised of a matrix stored in a memory, wherein the size and duration of the pulse are linked to different operating conditions,

wherein the electric motor generates a torque pulse for the purpose of taking up play in the drive line before torque from the drive engine occurs.

21. (Original) The drive system arrangement according to claim 20 wherein the drive line is further comprised of at least one sensor for measuring the effect of the torque pulse on the play in the drive line.

22. (Original) The drive system arrangement according to claim 21 wherein the control system is arranged so as to correct the size of the pulse in the matrix in the light of measured values from said sensors.

23. (Original) The drive system arrangement according to claim 16 wherein the change in load occurs when the drive engine changes from engine braking to driving.

Respectfully submitted,

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Date: July 1, 2004

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